Mem. Natn. Sci. Mus., Tokyo, (14), December 1, 1981

A New Miocene *Entemnotrochus* (Mollusca, Gastropoda) from the Izu Peninsula, Japan

By

Tomoki KASE* and Tetsuya KATAYAMA**

加瀬友喜*・片山哲哉**：伊豆半島産中新世アダンソンオキナエビスガイ属の1新種

Introduction

The Pleurotomariidae are very common, widespread and largely diversed in the shallow marine sediments of the Paleozoic and Mesozoic formations. Their Cenozoic representatives, however, are not dominant, and living species are rare, surviving on the shelf to bathyal bottom of some restricted areas, such as the seas off Japan, Molucca Islands and West Indies. Because the pleurotomariids are most primitive of living gastropods and because the habitats changed from shallow to deep seas during the mid-Tertiary times (HICKMAN, 1976), they are of unique interests in malacological, conchological and paleontological viewpoints.

The Tertiary strata of the Izu Peninsula, central Japan mainly consist of pyroclastic rock and are rather poor in fossils. Paleontological studies in this region have been focused mainly on benthic and planktonic foraminifers for age determination. Molluscan fossils have not been well documented, but NOMURA and NIINO (1932) described twenty and eight species from the Yugashima and Shirahama Groups, respectively, and a considerable number of species appeared in the faunal lists of the explanatory texts of geological maps published by the Geological Survey of Japan (SAWAMURA, 1955; SAWAMURA *et al.*, 1970) and also some other papers concerning regional geology (KITAMURA *et al.*, 1969, etc.).

Dr. Hiroshi OZAKI, ex-Director of the Department of Geology, National Science Museum, Tokyo, collected several fossil molluscs from the Miocene limestone of Makinogo, north of Shuzenji-cho, central part of the Izu Peninsula. These fossil molluscs were offered through his courtesy to one of us (T. KASE) for study. In 1980 and 1981, we undertook additional fossil collecting from this limestone under the project of the Natural History Research of the Japanese Islands conducted by the National Science Museum, Tokyo. In this paper, we describe a new species of *Entemnotrochus* as a part of the paleontological study of the Miocene limestone of Makinogo.

* Department of Geology, National Science Museum, Tokyo
国立科学博物館 地学研究部
** Central Research Laboratory, Sumitomo Cement Co. Ltd.
住友セメント 中央研究所

We are grateful to Dr. Hiroshi OZAKI of Saito Ho-on Kai Museum and Dr. Ienori FUJIYAMA of Department of Geology, National Science Museum, Tokyo, for their suggestions in studying the material. We are thankful to Dr. Itaru HAYAMI of University Museum, University of Tokyo, for critical reading of the manuscript. We also thank to Mr. Ryoichi MIYAGAWA of Aobadai Junior High School for helping us in the fossil collecting. Thanks are also due to Dr. Yasumitsu KANIE of Yokosuka City Museum and Mr. Akihikio MATSUKUMA of Department of Zoology, National Science Museum, Tokyo, for permission to examine the collections in those museums.

Geological Setting

The fossil described in this paper was collected from a small fossiliferous limestone body exposed in a valley at about 1.5 km east of Makinogo, Shuzenji-cho, Tagata-gun, Shizuoka Prefecture (Fig. 1). The formation bearing this limestome mainly consists of dacitic tuff with frequent intercalations of volcanic breccia and conglomerate of hornblende dacite. This formation belongs to the Shuzenji White Tuffs of the Yugashima Group by SAWAMURA (1955) and also to the Kaden (=Kadono) Formation by KITAMURA *et al.* (1969). It trends north to northwest and gently dips eastward. The contact between the limestone and surrounding volcanic sediments cannot be observed owing to bad exposures, but the maximum thickness of this limestone may be about 50 meters. The limestone bearing gastropods mainly consists of massive biomicrite which contains much terrigenous materials such as oxidized pebbles of hornblende dacite, minute grains of oxidized magnetite and weathered red-colored mud in the matrix and in the cavities of larger fossils. Limonitic ooids with concentric laminations are also found around detrital nuclei and their reworked fragments (Fig. 2). Similar ferruginous oolites are known in the Minette type iron ores (BORCHERT, 1965) and are

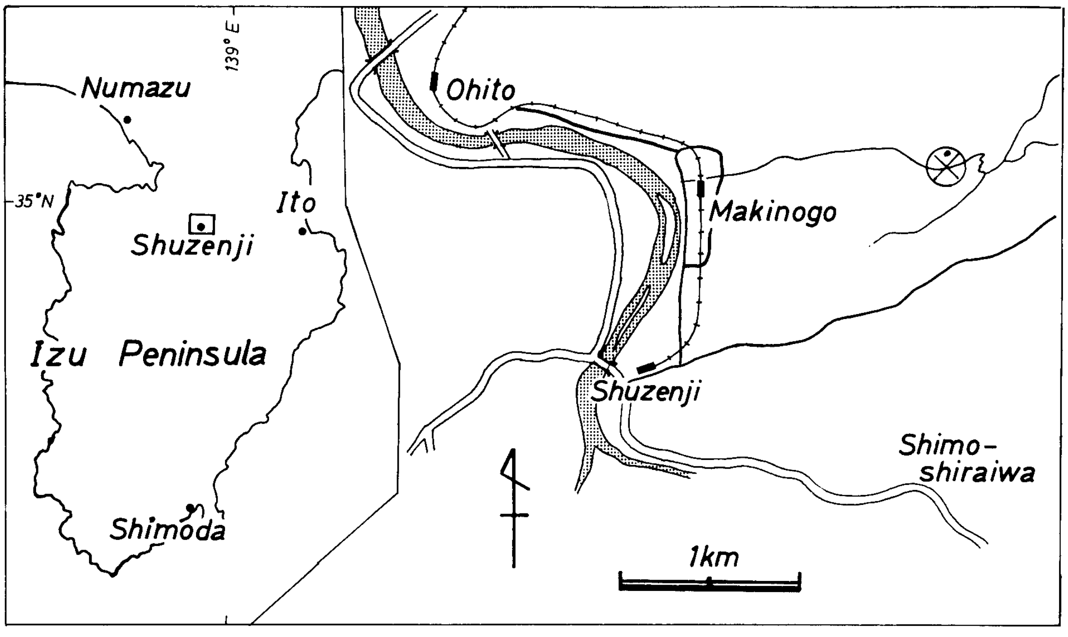

Fig. 1. Map showing the fossil locality.

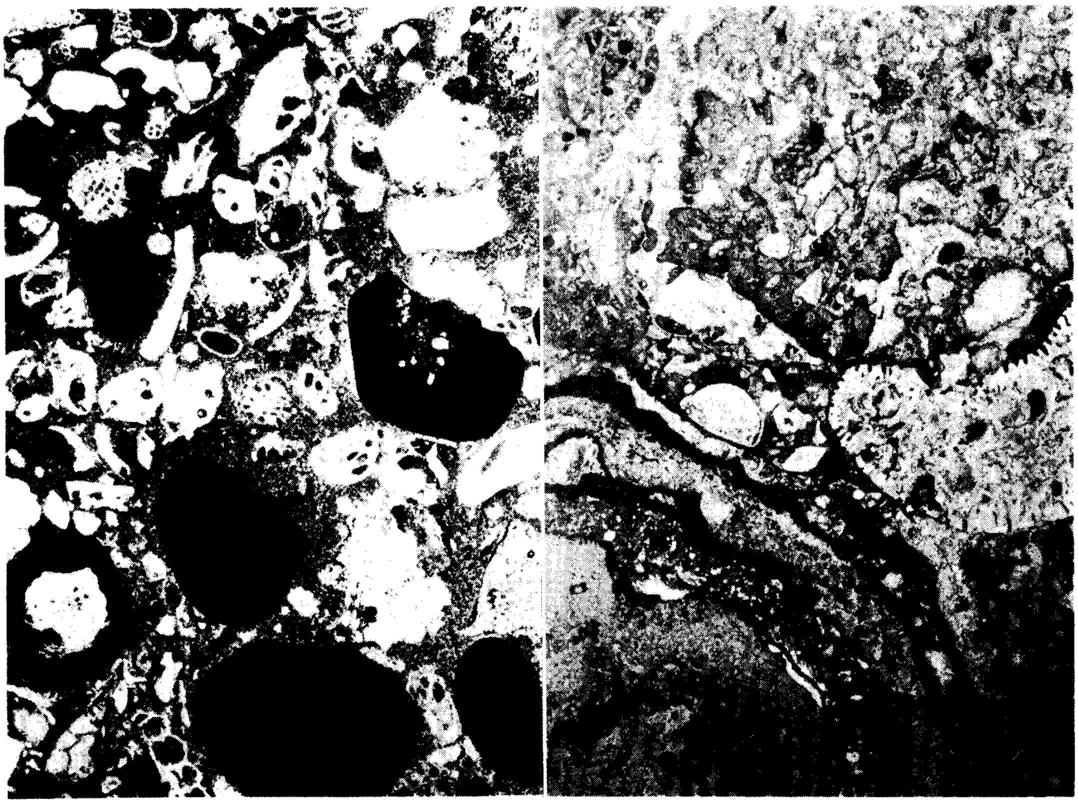

Fig. 2 Fig. 3

Fig. 2. Detrital facies bearing oolitic limonite. Sorted debris of bryozoans (white) and limonitic ooids (black, alternating admixture of hematite and geothite) are embedded within a micritic matrix of the limestone. (×8)

Fig. 3. Reef-wall facies of the limestone. Intergrowths of the reef-building organisms are developed. Lower left is the thick alternations of crustose coralline algae (opaque laminae), encrusting foraminifer *Acervulina inhaerens* (mesh-like) and early lithified micritic crust (dark sheet) on a coral mass (corner). (×8)

associated widely with the fossiliferous shallow water limestones in the Silurian Appalachian Basin (HUNTER, 1970). Futhermore, this limestone contains scleractinian corals, but their colonies or reef structure are obscure by the naked eye. Molluscan fossils occur sporadically, and the following species are identified; *Cellana*? sp., *Turbo* sp., *Cerithium*? sp., *Triplostephanus* sp., *Conus* sp., Cypreaidae gen. et sp. indet., *Barbatia* sp., Pectinidae gen. et sp. indet., *Vasticardium* sp., *Periglypta*? sp. and *Penicillus* sp. cf. *P. giganteus* (SOWERBY), etc. In thin sections, debris of articulate coralline algae, branching bryozoans, hydrocorals, echinoids, barnacles, ostracodes, annelids, foraminifers and radioralians are randomly oriented. Intergrowths of crustose coralline algae, encrusting bryozoans*, such as *Steginoporella magnilabris* (BUSK), *Thalamoporella* sp. and *Colletosia* sp. cf. *C. magnilabris* (MOLL), and encrusting foraminifers, such as *Sporadotrema cylindricum* (CARTER), *Homotrema rubrum* (LAMARCK), *Acervulina inhaerens* SCHULTZE var. *plana* (CARTER) and *Planorbulinella larvata* (PARKER et JONES), are observable. These organisms commonly enrcust on the coral mass or detritus

* We thank to Mr. Shinji ARAKAWA of the Chiba University for identification of these bryozoan specimens.

and build up a local framework in the massive limestone (Fig. 3). This limestone sometimes contains oolitic pellets and intraclasts which include *Nephrolepidina japonica* (YABE). Following benthic foraminifers are also encountered in the detrital part of this limestone; *Gypsina globulus* REUSS, *Amphistegina radiata* (FICHTEL et MOLL), *Rotalia* sp., *Elphidium* sp., *Cibicides* sp., *Pyrgo* sp., *Triloculina* sp., and *Quinqueloculina* sp., etc. Planktonic foraminifers are rather rare. Several species of coralline algae from this limestone were described by ISHIJIMA (1968).

As to the faunal and floral assembalges and textural lithology in thin sections, this limestone is nearly identical with the reef-wall to reef-breccia limestone with some marginal elements of a reef, as interpreted by HENSON (1950) and FORMAN and SCHLANGER (1957), because of the presence of massive framework of sessile organisms and prevailing unoriented fragments of similar members of fossils. These characteristics of the limestome at Makinogo indicate that the main part of this limestone deposited under shallow and nearshore evniroment with strong wave action.

The precise geological age of this limestone is not clear, because of the lack of fossil for age determination. However, it is considered to be the Late Miocene or older, because the planktonic foraminifers of the overlying Shimoshiraiwa Formation of KITAMURA *et al.* (1969) indicate BLOW's N14 (SAITO, 1963; IKEBE & CHIJI, 1971).

Systematic Description

Family Pleurotomariidae SWAINSON, 1840

Genus *Entemnotrochus* P. FISCHER, 1885

Entemnotrochus ozakii KASE et KATAYAMA, sp. nov.

(Plate 4, Figures A–C).

Type. Holotype [NSM-PM15108, R. MIYAGAWA Coll.].

Diagnosis. A species of *Entemnotrochus* similar to *E. rumphii* but characterized by much narrower selenizone situated at a little posterior of mid-whorl.

Description. Large-sized, thin-tested and broadly phaneromphalous trochiform shell with height slightly smaller than width. Spire attaining three-fourths of length of total shell height. Protoconch not preserved. Apical whorls more or less coeloconoid, but other whorls nearly isometrically expanded with angle in neighborhoods of body and penultimate whorls about 80°. Whorls at least five in number and separated by weakly impressed suture. Whorl sides very weakly inflated as a whole; area below suture more inflated than that above suture, both of which are separated by a weak spiral depression at mid-whorl. Body whorl subangulated peripherally, but not forming any distinct peripheral bulge. Base convex, smooth with broad and very deep umbilicus. No detectable angulation at umbilical margin. Umbilical wall steep and ornamented by growth rugae. Aperture broken but subquadrangular in outline. Shell surface of whorl sides ornamented by narrow spiral and collabral grooves; spiral grooves irregularly spaced, variable in prominence and about a dozen in number

above and below selenizone, and collabral grooves shallower and slightly wider than spiral ones and prosocline and orthocline above and below selenizone. Selenizone situated at a little posterior of mid-whorl, very narrow, represented by a convex cord being delimited by spiral grooves. Exhalant slit not preserved.

Measurements in mm.

Specimen	Height	Width	Height of aperture	Height of body whorl	Apical angle
NSM-PM15108	95+	116	43	62.5	ca.80°

Discussion. Only one specimen is available for this study. The shell is not perfectly preserved, but the surface sculpture of the whorl sides, smooth base, deeply and broadly excavated umbilicus and nature and position of selenizone of this specimen allow determination of its generic position and specific comparison with related species.

Although the umbilicus is covered by sediments, the steep umbilical wall indicates that it is very deep. The shell material on the base is imperfectly preserved. However, partially preserved shell material at apertural and umbilical areas shows that the base of this specimen is smooth having no ornamentation except for growth rugae. Judging from the columellar lip, at least a half of volution of body whorl is broken off, so that the original shell diameter may attain about 15 cm. The basal periphery of adapertural side is carinated in front view, but is due to the attachment of parietal shell of the broken body whorl. The selenizone of this specimen, as illustrated in Fig. 4, is well observable at the whorl side of the penultimate whorl and is very narrow if compared with other species of this genus.

Two living (*Entemnotrochus adansoniana* and *E. rumphii*) and three fossil species (*E. shikamai* KANIE, 1973, from the Miocene of central Japan, *E. panchangwui* LIN, 1975, from

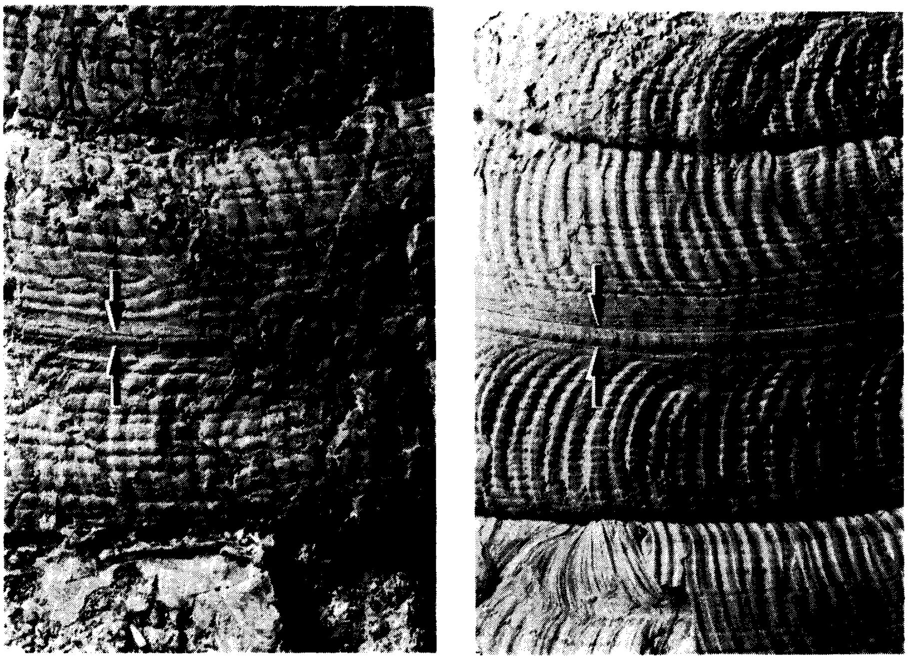

Fig. 4. The selenizone of *Entemnotrochus ozakii* KASE et KATAYAMA (left) and *Entemnotrochus rumphii* (SCHEPMAN) (right). Allows indicate the positions of grooves delimited the selenizones. (×2.0)

the Middle(?) Miocene of central Taiwan and *E. siuyingae* LIN, 1975, from the Middle(?) Miocene of central Taiwan) of *Entemnotrochus* are known. In the classification of pleurotomariid gastropods the position of selenozone, its width and pattern of ornamentation are the most useful taxonomic characters for delineating related groups of species and should be weighted more heavily than shell outline and umbilical characters (COX, 1960; HICKMAN, 1976). Among the species listed above, *Entemnotrochus ozakii* is distinguishable from *E. adansoniana* and *E. panchangwui* by the wider shell outline and more anteriorly situated selenizone. The present new species is more similar to *E. siuyingae.* LIN's specimen is very small and the nature of surface ornamentation and selenizone are not clear. Judging from LIN's description, however, the selenizone of *E. siuyingae* is situated at slightly anterior part from mid-whorl.

E. ozakii is very close to *E. rumphii,* living in the sea off Japan, East China Sea and Moluccas Islands. In the shell outline, weakly impressed suture, surface ornamentation, characteristics of basal area and position and nature of selenizone the two species are essentially similar. The only difference between them is the width of selenizone; the width of selenizone of *E. ozakii* is about two-fifths of that of *E. rumphii.* The surface ornamentation is slightly coarser and the whorl sides are more flattened than those of *E. rumphii,* but these characters may be considerably variable within each pleurotomariid species.

KANIE (1973) described *Entemnotrochus shikamai* from the Miocene Senhata Conglomerate Member of Boso Peninsula, central Japan. We could make a close examination of the specimen stored in the Yokosuka City Museum. The shell of this specimen is almost entirely lost except for that of base near aperture, so that the surface ornamentation cannot be observed. The aperture is completely preserved, and the selenizone and exhalant slit can be traceable on the internal mold. HICKMAN (1976) pointed out that the width of selenizone on the internal mold of some species does not coincide with the true width of its selenizone because of the difference of width and ornamentation of selenizone between the inner and outer shell layers. However, it is considered that the trace of exhalant slit on the internal mold indicates its true width, from which its width can be assumed. The width of exhalant slit near aperture of Kanie's specimen is measured 3.5 mm, and the axial length of whorl side above basal periphery, on the other hand, is 41.5 mm. This indicates that the width of selenizone of *E. shikamai* is not so different from that of *E. rumphii,* and, therefore, *E. ozakii* can be distinguished from *E. shikamai.* The specific comparison between *E. rumphii* and *E. shikamai* must be discussed on the basis of better preserved material, but the length of exhalant slit of *E. shikamai* attains about a quarter of volution which is much shorter than that of *E. rumphii.*

要　　約

伊豆半島中部，修善寺町牧ノ郷東方の湯ケ島層群中の石灰岩より得られたオキナエビスガイ科の1新種 *Entemnotrochus ozakii* KASE et KATAYAMA を記載した。この標本を産出した石灰岩は最大層厚約 50 m で，主に塊状のバイオレミクライトよりなり，陸源物質として角閃石石英安山岩の酸化礫や酸化した磁鉄鉱粒子，赤色風化土壌，等を含む他，褐鉄鉱が規則的な同心円状に被覆した鮞状石やその破片も見い出される．また，この石灰岩は二枚貝類・腹足類のほかに，被覆性のコケムシ類，被覆性の無節サンゴ藻類，被殻性有孔虫類，等の造礁生物化石を多産し，これらは相互に被覆しあって部分的に framework を形成している．

薄片中では以上のほかに有節サンゴ藻類，分枝状のコケムシ類，棘皮動物，蔓脚類，貝形類，多毛類，底性および浮遊性有孔虫類，ヒドロサンゴ類，放散虫類の破片が識別された．以上に述べた本石灰岩の主要部の特徴は，HENSON (1950) や FORAM and SCHLANGER (1957) の reef-wall limestone あるいは reef-breccia limestone に類似し，鮞状石の産出とともに，牧ノ郷東方の石灰岩が陸ないし島に近接した波浪の影響のある浅海に堆積したことを暗示するものである．

本論文で記載した標本は不完全で，体層の約½巻きが破損しているため，殻口外唇の切れ込みは観察できない．しかし広く開いた深い臍孔を持つこと，平滑な殻底を持つこと，selenizone の特徴により *Entemnotrochus* 属に帰属する．現在までに本属は 2 種の現生種と 3 種の化石種が知られており，それらの中で *E. ozakii* は *E. rumphii* (SCHEPMAN) に最も近縁と考えられる．殻形，表面装飾等のあらゆる点で両種は類似するが，*E. ozakii* の selenizone の幅は *E. rumphii* のそれの⅖しかない．COX (1960) や HICKMAN (1976) が指摘しているように，selenizone の特徴はオキナエビガイ科の種内で極めて安定した形質と考えられているので，上記 2 種は種のレベルで区別される．

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Explanation of Plate 4

Entemnotrochus ozakii KASE et KATAYAMA, sp. nov. ($\times 0.9$)

A. Frontal view.
B. Basal view.
C. Apical view.


C
B
A